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Unplasticized polyvinyl chloride (PVC-U) pipes for water supply — Recommended practice for laying

Canalisations en polychlorure de vinyle non plastifié (PVC-U) pour l'adduction d'eau — Pratique recommandée pour la pose

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Contents

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The main task of ISO technical committees is to prepare International Standards. In exceptional circumstances a technical committee may propose the publication of a technical report of one of the following types:

— type 1, when the necessary support within the technical committee cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development requiring wider exposure;

— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical reports are accepted for publication directly by ISO Council. Technical reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 4191, which is a technical report of type 3, was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*.

The reasons which led to the decision to publish this document in the form of a Technical Report type 3 are explained in the Introduction.

This Technical Report gives advice for avoiding errors in the installation of plastics pipes. Certain other requirements could be put forward to cover special safety or installation conditions.

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Unplasticized polyvinyl chloride (PVC-U) pipes for water supply — Recommended practice for laying

0 INTRODUCTION

This subject was studied by working group 2 (WG 2), now sub-committee 2 (SC 2) of ISO/TC 138 and resulted in the production in 1979 of draft proposal DP 4191.2. WG 2 has examined the comments received on this draft proposal and decided to convert it into a type 3 Technical Report, so as not to oppose certain national regulations already in existence, which are not always taken into account by this document (national regulations still take precedence over an ISO Technical Report). In particular, national safety regulations shall be followed during the laying of buried PVC pipes for water supply.

1 SCOPE

This Technical Report gives instructions for the correct use and installation of unplasticized PVC pipes for water supply. The geometrical, mechanical and physical properties of the pipes and fittings, covered by this Technical Report, are given in DIS 4422.

2 FIELD OF APPLICATION

This Technical Report is applicable to PVC pipes for :

- buried pipelines and branches for water supply
- overhead pipes for water distribution to the interior and exterior of buildings
- the transport of water under pressure up to a temperature of 45°C for general use, and likewise for potable water supply

NOTE - Only companies with competent staff should be awarded contacts for the laying of pipes. The appropriate safety regulations of the contry should be complied with.

3 REFERENCES

DIS 4422 - Unplasticized polyvinyl chloride pipes and fittings for water supply - Specifications.

TR 10501 - Thermoplastics pipes for the transport of liquids under pressure - Calculation of head losses.

4 PARAMETERS INFLUENCING DESIGN

4.1 Nominal pressure and service pressure

4.1.1 The nominal pressure and permissible service pressures for water at temperatures up to 45°C are given in DIS 4422, table 1.

4.1.2 The maximum permissible service pressures have been calculated on the basis of well established data, taking a service life of at least 50 years of continuous service, with a safety coefficient in excess of 2.

4.2 Precautions

4.2.1 Where a pipe is likely to operate under abnormal mechanical or physical conditions, it may be beneficial to use a stronger design than for normal conditions.

4.2.2 The pipe elements shall not be exposed to flames or to radiant heat which is likely to raise their surface temperature to more than 60°C.

4.2.3 Where national regulations authorise the use of metal pipes for the earthing of electrical installations, care should be taken to maintain electrical continuity of the pipes, or to provide a new earth.

4.2.4 Unplasticized PVC does not conduct electricity and thus cannot be used for earthing; neither can these tubes be thawed by electrical means using the pipe as a conductor.

4.2.5 On account of the high electrical resistance of unplasticized PVC pipes, precautions shall be taken where hazards exist due to static electricity.

4.2.6 Unplasticized PVC is susceptible to splitting; screw cutting or tapping on site is therefore not recommended.

4.2.7 The forming of joints and bends on site is not recommended.

4.2.8 The handling and laying of unplasticized PVC pipes require the taking of reasonable precautions. Despite their robustness which is usually more than adequate for withstanding normal laying, it should be known that their constituent material becomes less robust at low temperatures encountered in winter.

4.2.9 The pipes shall not be covered with solvents or aggressive paints.

4.2.10 For drinking water networks, refer to sub-clause 7.1.4 of DIS 4422.

5 HYDRAULIC PROPERTIES

PVC pipes have a smooth polished internal surface which considerably delays the formation of scale.

5.1 Loss of head

The universal table given in annex to ISO/TR 10501 [1] gives the loss of head to be allowed for thermoplastics pipes with a smooth internal surface.

5.2 Internal diameter

As it is the external diameter of an unplasticized PVC pipe which is specified, the internal diameter varies according to its pressure series S (see DIS 4422, table 1), and this should be taken into account when calculating the hydraulic properties.

Note - The nominal size DN cannot be subject to measurement and shall not be used for purposes of calculation, as DN is only loosely related to manufacturing dimensions

6 ASSEMBLY METHODS

6.1 General

6.1.1 Unplasticized PVC pipes complying with DIS 4422 are manufactured by continuous extrusion, but they are normally supplied in standard lengths. Some have smooth ends and are assembled by means of separate sleeves, while others are provided with a prefabricated socket at one end.

6.1.2 The joints and fittings to be used with unplsticized PVC pipes are specified in DIS 4422. They are designed so as to have a service life at least as long as that of the pipes themselves. As a result, they can withstand the test pressures applicable to the series of pipes concerned. (see DIS 4422, § 6.1.1.)

6.1.3 The types of joints can be divided into three categories,

(1) cemented joints, where adhesive is applied both to the spigot end of the pipe and in the socket (see § 6.2). These joints withstand "end thrust"

(2) automatic joints, where an elastic seal is automatically compressed and forms a sealed joint when the spigot end is inserted into the socket (see § 6.3)

(3) mechanical joints, in which a sealing washer is compressed by any external means of tightening (see § 6.4)

6.1.4 These three categories of joint may form an integral part of sockets already provided on the pipe itself : in this case they are termed "preformed joints". As an alternative, two joints may be combined in a double socket for joining pipes with smooth ends : in this case they are termed "sleeves".

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6.1.5 The pipe joints described in annex 2, § 2 and 3, in which water tightness under pressure relies on the compression of an elastic sealing element, offer little resistance to end thrust which occurs at bends, flanges, valves, etc; consequently, the pipe should be adequately anchored if such joints are used. Pipes shall in any case be suitably anchored.
There are also special sleeves with high tensile strength capable of holding where there is thrust (see annex 2, figure 2c).

6.1.6 If it will be necessary at some time to dismantle the piping, mechanical joints should preferably be used.

6.2 Cemented joints

6.2.1 The dimensions of the sockets and spigot ends shall meet the requirements of DIS 4422 if successful cemented joints are to be obtained. A typical joint is shown in figure 1b of annex 2.

6.2.2 The adhesives shall meet the functional reqirements of DP 9311 and the identification characteristics (as in DIS 7387/1) specified by the manufacturer.

6.2.3 The adhesives shall not contain any substance which is likely to affect the taste or odour of the water, or to have a toxic effect, or to encourage the growth of bacteria.

NOTE - It is however necessary to rinse recently laid pipes.

6.2.4 Jointing operation

According to the nature of the adhesive and the clearance tolerances between the spigot end and the socket (§ 5.2.1 of DIS 4422), there are different methods of cementing. The manufacturer's instructions shall be followed. There are however some points common to all cemented joints :

(1) Adhesive can be inflammable : do not smoke in the area in which it is being used. The adhesive shall be applied in a well ventilated space.

(2) The adhesive shall have the required viscosity, it shall not be diluted.

(3) The pipe shall be :

- cut square to its axis
- chamfered at the end to prevent the over-spill of adhesive (see figure 1a, annex 2)

(4) The surfaces to be joined shall be clean, dry and free from grease

(5) Special precautions shall be taken when cementing is performed at temperatures close to freezing.

(6) Apply the adhesive in an even layer in a longitudinal direction, but with a thicker coating on the spigot end.

(7) Cementing shall be performed quickly. For diameters ≥ 90 mm, two persons are required to apply the adhesive to the spigot end and to the socket simultaneously.

(8) Smudges of adhesive shall be removed as soon as the joint has been made. Once the joint is made, leave to dry without disturbing for at least 5 minutes.

(9) The joint becomes resistant to pressure only after an additional period. This period depends upon :

- the type of adhesive (see manufacturer's instructions)
- the play between the socket and spigot end
- the ambient temperature (see table 4 of annex 1)
- the test pressure

(10) Special bonding techniques shall be used for diameters of 200 mm and above.

6.3 Joints using an elastic sealing ring (automatic joints)

6.3.1 An automatic joint comprises an elastic sealing element which is automatically compressed and which forms a seal when the spigot end is inserted into the socket. The elastic sealing ring is located in the socket; the profiles of the ring and of the socket depend on the manufacturer's design. The rings to be used shall be those supplied by the manufacturer for his own assembly system. If the elastic sealing ring is not in place at the time of delivery, clean the groove, remove any foreign bodies and then locate the ring correctly in the groove.

6.3.2 Manufacturers generally suggest sealing rings of natural or synthetic rubber, or a mixture of the two (see DIS 4422, § 9).

6.3.3 Automatic joints are not intended to withstand end thrust. Particular attention shall be paid to the correct anchorage of the elements. The anchorage blocks shall be designed to withstand the trust due to the maximum pressure which the pipe may be sujected to, i.e. normally the test pressure. It is recommended that direct contact between the unplasticized PVC pipe and the anchorage block be avoided, by interposing an appropriate flexible polyethylene film. Figures 7a, b and c of annex 2 give examples of arrangements.

6.3.4 Correct assembly by means of an automatic joint requires that the spigot end be chamfered and correctly lubricated prior to insertion into the socket. Where the pipe manufacturer does not supply a lubricant, use one which does not have any harmful effect on the pipe, fitting, or elastic sealing ring; if the pipe is to carry potable water, the lubricant shall not be toxic, shall not impart any taste or odour to the water, and shall not encourage the growth of bacteria.

As soon as the spigot end has been lubricated, it should be introduced into the neighbouring socket, after it has been correctly aligned, so as to avoid any risk of soiling or pollution. The spigot end shall be inserted into the socket up to the

reference mark made by the manufacturer. The penetration of the tube into the sealing element of the socket guarantees good holding under pressure. Where there is no mark, insert the spigot end fully if laying takes place in cold weather. If laying takes place in warm weather, it is recommended that the pipes be cooled before assembly, for example by placing at the bottom of the trench.

NOTE – The pipes may be recut on site but the cut shall be square and the end shall be chamfered. Sealing rings which have slipped out of place and dirt under the sealing rings are the most frequent causes of leaks : both problems can be avoided by correct operation.

6.4 Mechanical joints

6.4.1 Compression joints (see figure 3, annex 2)

These are similar to automatic joints, the only difference being that the elastic ring is compressed by means of an external tightening system. An example of this is given in figure 3, where the joint is bolted or screwed onto the socket. Mechanical compression joints are useful for joints to pipes of other materials, such as asbestos cement or cast iron, where necessary using adapters.

Care should be taken not to overtighten the elastic ring which is in contact with the PVC-U pipe, otherwise there is a risk of the pipe deforming under the thrust exerted by the ring and the tightness of the joint can be impaired. Because of the smooth surface of an PVC-U pipe, sealing is obtained with a light compression. For the lightest pipes, an internal sleeve may be used to increase their rigidity.

6.4.2 Threaded joints

There is a range of threaded joints for assembly to metallic pipes :

- Unplasticized PVC adapter fittings (see figure 4a, annex 2) as in DIS 4422, § 5.2.3.

- PVC and metal adapter fittings (see figure 4b, annex 2) as in DIS 4422, § 5.2.3.

In general unplasticized PVC does not thread well on account of its susceptibility to splitting.

6.4.3 Flanged joints

Flanges can be used (see figure 5, annex 2) for joining together unplasticized PVC pipes, and for joining them to metal flanges, valves and flanged fittings. The joint is obtained by compression of a gasket or ring placed against the flange. Gaskets or rings of plasticized PVC, or containing aggressive substances shall be avoided. The flanges may be assembled

a) by cementing (onto a pipe spigot) of a flat joint PVC fitting for a mating flange (figure 5b, annex 2) as in DIS 4422, § 5.3).

b) by cementing (to a pipe spigot) of a PVC fitting with a groove and O-ring for a mating flange (figure 5c, annex 2) as in DIS 4422, § 5.3.

c) by using a threaded joint in combination with a metal flange (figure 5c, annex 2), as in DIS 4422, § 5.2.

7 BENDS

7.1 Cold bending

Unplasticized PVC pipes with external diameter up to 200 mm have a degree of flexibility and can bend to follow the windings of the ground and upward turns; however, the radius of curvature (R) shall not be less than about 300 times the external diameter of the pipe. Figure 6, annex 2, shows a method of cold bending and adjusting, for pipes in standard lengths of 6 m and 12 m. With certain types of joint, there may be limits to the possible range of bending radii.

7.2 Hot bending

Bends can be made with a minimum bending radius of 2.5 to 5 times the diameter of the pipe, utilizing the thermoplastic properties of the material. However, this is a delicate operation as it depends on the external diameter and the thickness of the pipe and it is not recommended that it be carried out on site.

8 STORAGE, HANDLING AND TRANSPORT

8.1 Storage

8.1.1 Unplasticized PVC pipes are durable despite their lightness. Consequently handling is very easy and they are more likely to be mistreated than their metal counterparts. This tendency should be eliminated and reasonable precautions taken during handling and storage to ensure that the pipes are not damage.

8.1.2 Unplasticized PVC pipes shall be stacked on a reasonably flat surface, free from sharp objects, stones or projections likely to deform or damage them.

8.1.3 Lateral supports shall be installed at maximum intervals of 1.5 metre and these supports shall preferably consist of posts at least 50 mm wide. If the tubes are in bundles of approximately 1 x 1 m, the lateral supports shall be spaced at greater distances up to 2.5 to 3 metres.

8.1.4 The pipes shall be supported evenly over their whole length. If this is not possible, they should be carried on wooden supports of at least 50 mm usable width, the axes of which are at most 2 metres apart. If the tubes are in bundles of approximately 1 x 1 m, the supports may be spaced up to 3 m